GRADE 10

23

ENERGY EDUCATION COURSE TRIAL

REPORT COMPILED BY
WASHBURN & GILLIS ASSOCIATES LIMITED
FEBRUARY 1985

CREDA PROJECT 2025

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
Energy Division
Energy Secretariat
P.O. Box 6000
Fredericton, N.B.
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Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

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D I S C L A I M E R

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TABLE OF CONTENTS

PAGE

Table of Contents ..... (i)

List of Tables ..... (ii)

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION AND BACKGROUND 2

2.1 Aims 4
2.2 Objectives 4
2.3 Alternatives 5
2.4 Energy Savings 6
2.5 Future Applications 6

3.0 DESCRIPTION OF DEMONSTRATION 7

4.0 DEVELOPMENT AND USE OF MATERIALS 10

5.0 COST ANALYSIS 13

6.0 EVALUATION 16

6.1 Trial Run 16
6.2 Final Report 16

7.0 CONCLUSIONS 21

8.0 RECOMMENDATIONS 22

APPENDIX A - MATERIALS DEVELOPED A-1

APPENDIX B - EVALUATION OF TRIAL RUN (1982) B-1

APPENDIX C - 1984 EVALUATION C-1

LIST OF TABLES

		PAGE
TABLE 1	Participants	10
TABLE 2	Overall Budgets	14
TABLE 3	Cost Per Phase	14
TABLE 4	1984 School Survey	17
TABLE 5	Schools Evaluating Unit in 1984	18
TABLE 6A	Summary of 1984 Evaluation	19
TABLE 6B	Summary of 1984 Evaluation	20

1.0 EXECUTIVE SUMMARY

One of the projects funded by the Canada/New Brunswick Conservation and Renewable Energy Demonstration Program was an energy education project of the New Brunswick Department of Education. Its purpose was to enrich the energy conservation content of the high school grade 10 physical science course through the incorporation into the course of a two-week demonstration project.

The demonstration project illustrates the importance of energy conservation and the use of renewable energy. The educational materials were developed in both official languages and include instruction manuals, laboratory experiments and a computer-assisted heat loss demonstration with student involvement.

The materials were developed by a team of educators, writers and technical experts. The process took sixteen months and cost $29,711.

The materials have been evaluated twice. The first evaluation was part of the development process. The second evaluation took place in 1984. These show that use of the materials increases the students' understanding of the need for energy conservation and of ways of achieving energy conservation through improving the construction and operation of a building.

1.0 Résumé

Le projet d'éducation en matière d'énergie du ministère de l'Education du Nouveau-Brunswick figure parmi l'un des projets financés en vertu du Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables. Ce projet avait pour but d'enrichir le contenu en matière d'économie d'énergie des cours de physique de la 10ème année en y ajoutant un projet de démonstration d'une durée de deux semaines.

Celui-ci permet d'illustrer l'importance de l'économie d'énergie et de l'utilisation des énergies renouvelables. Le matériel pédagogique, développé dans les deux langues officielles, comprend un manuel d'instruction, des expériences en laboratoire et une démonstration, faite au moyen d'un ordinateur et impliquant les étudiants, sur les pertes de chaleur.

Une équipe d'éducateurs, d'auteurs et d'experts techniques a développé le matériel. Le processus, d'une durée de seize mois, a coûté 29,711$.

C'est par deux fois qu'on a évalué le matériel. La première évaluation faisait partie du processus de développement et la seconde a eu lieu en 1984. Ceci permet de démontrer que le matériel a su approfondir la connaissance des étudiants face au besoin de l'économie d'énergie et aux manières d'y arriver en améliorant la construction et le fonctionnement d'un édifice.

2.0 INTRODUCTION AND BACKGROUND

In 1980, the Department of Education of the Province of New Brunswick recognized that there was a need for the inclusion of demonstration projects on renewable energy in the high school curriculum. In July of 1981, funding was approved by the Federal-Provincial Management Committee for CREDA Project 2025 to develop the first of a series of two week demonstration projects to enrich the energy content of the high school grade 10 general science course.

Approximately twenty-five percent of the high school students in New Brunswick take General Science 10.3. It is given in French and English.

The work included the logical steps of course development up to the point where educational materials and aids were produced in both official languages in quantities required for the whole Province. It did not include province-wide teacher training or course evaluation and updating.

The course inclusion had several requirements:

1. It had to complement the other material given in General Science 10.3.
2. It needed good handbooks and support material in both French and English.

3. It had to be at a level which the students could understand, and to be effective in achieving its educational aims.
4. The material had to meet the needs of the teachers and the teachers should want to use the materials.

In order to accomplish this, the Department of Education's science consultants and a number of teachers and students were involved at various stages of the project development to ensure that the course addition would be appropriate for the Region and that it would have wide use by the teachers. The stages of development were:

1. Planning
2. Preliminary development of materials
3. Field testing and revision
4. Production of materials

Province-wide teacher training, regular evaluation and updating were part of the overall plan, but not part of this project. They depended upon the continuing interest and involvement of the Department of Education and its science consultants.

2.1 Aims

The aims of the project were to provide students in the general and occupational program with instructional materials designed to:

1. stimulate student interest in energy supply and demand for the province, the region and the country;
2. enable students to differentiate between renewable and non-renewable energy and to know the importance of conserving the latter;
3. utilize the concepts of energy balance and heat transfer;
4. develop an understanding about the ways to conserve energy in buildings.

2.2 Objectives

The purpose of the project was not only to produce the materials but to assess the effectiveness of the method of developing the materials. This experience would be used in further projects aimed at increasing the students' knowledge about energy. The materials to be produced were:

1. Teacher and student "handbooks" on the use of the materials in the "kit" and on the principles that will be illustrated.
2. Prefabricated test equipment that the students can assemble.
3. A list of test material easily acquired in the classroom or home.
4. A list of related references, including audio-visual aids available.

2.3 Alternatives

Some of the subjects which were considered for this project were:

1. The ability of some materials to transmit and radiate heat and of others to block the passage of heat.
2. Heat generation through the use of muscles, friction, material deformation, chemical reactions, etc.
3. Ways to harness the sun using flat plate and focussing collectors, greenhouses, as well as photovoltaics.
4. Power generation from wind and tides.
5. Energy transformation. The wind, sun and tides do not necessarily deliver energy when it is wanted or in the form wanted.
6. Energy storage: electrical, chemical, gravitational and thermal.
7. Thermal storage, including storage in rocks or liquids or in materials that undergo a chemical phase change.

In the first phase, the planning phase, of the project it was decided that item one would be the subject for this demonstration project. This subject would lend itself to the discussion of energy conservation in buildings. General Science 10.3 is a course taken mainly by boys. It is not a university preparatory course. This subject was chosen because many of the students taking the course would be involved with the building trade.

2.4 Energy Savings

The expected end result of this course would be that some future homeowners, up to twenty-five percent of the student population, would have a greater appreciation for the need to conserve energy and the knowledge of how to achieve this. Some of the homeowners would also be home builders. Although there would undoubtedly be energy savings, these would occur in the future and cannot be quantified at this time.

2.5 Future Applications

This project can be adapted by any provincial department of education or any other educational institution. In Newfoundland, the provincial Department of Mines and Energy and of individual School Boards have cooperated to adapt the New Brunswick materials for their schools. There has been a successful trial run and the materials are currently being printed for use throughout the province.

The method used to develop these educational materials has been successful. It can be used to develop materials for other topics on energy.

The expertise developed through this and other energy projects has been used by the consultant to develop other educational aids for Energy, Mines and Resources Canada. The consultants are currently revising material for an adult education course and have successfully conducted a trial run of this material in Nova Scotia (Contract 03GT.2321G-4-6289).

3.0 DESCRIPTION OF DEMONSTRATION

The materials which were developed in New Brunswick in 1981 and 1982 included two manuals, one computer program and a kit list. For the trial run, an experimental kit was supplied to the teachers as well as introductory letters and a pre-test for evaluation purposes. Because of budget restraints, the kits were not supplied when the materials were subsequently circulated to all the schools. For the trial run, each kit had cost about fifty-five dollars, however it was felt that much of the equipment was readily available in a high school science laboratory. Appendix A contains the table of contents of both manuals, the kit list, the introductory letter and the pre-test.

The student manuals contain text, figures, tables and appendices. There are quizzes for directed reading in each chapter. It also describes five experiments which the students could perform in the lab which demonstrated the material in the text.

Each chapter in the teacher manual contains an overview of the chapter, the objectives, an outline, the time which should be allotted to the chapter, how to develop the lesson, how to motivate the students and the answer to the quizzes. A list of terms which might be new to the students was developed. They are listed in the teacher manual. The first time one of these words is used in the student manual it appears in capitals; the words are then included in a glossary, complete with meanings, at the end of the student text. At the end of the teacher manual there is a final test with multiple-choice items.

The objective of the first chapter is to enable the students to:

1. Define the terms energy and power and know the units for measuring each.
2. Explain the sources of the earth's energy.
3. Explain why fossil fuels are useful as a source of energy and why alternative sources must be found.
4. Relate energy demand and consumption to the world, Canadian and New Brunswick situations.
5. State reasons for the conservation of non-renewable resources and for using renewable resources as energy sources.
6. Explain the term space heating and relate it to the consumption of energy.

To attain this objective the text contains figures and tables illustrating energy sources, reserves and use. In this and subsequent chapters there are many questions to stimulate the students' interest. The questions are repeated in the teacher manual, along with the correct answers.

The objective of the second chapter is to give the student an understanding of the ways in which heat is transferred especially as they relate to heat losses from heated space in the winter. The text of chapter two describes five demonstrations. Three illustrate the methods of heat transfer: radiation, convection, and conduction. The final two give the students a hands-on understanding of the insulating value of certain materials and the proper placement of a vapour barrier.

The objective of the third and final chapter is to enable the students to:

1. Identify the components of a house through which heat is lost.
2. Calculate the appropriate areas and volumes that relate to heat loss.
3. Use R-values to calculate the rate of heat loss in watts per degrees Celsius.
4. Select appropriate methods to improve the R-value of the various components of the house.
5. Use the computer to calculate dollar savings associated with improving the R-values and reducing infiltration.
6. Use the computer to calculate the pay-back time associated with with improvements, such as re-insulation, caulking and sealing.

There are two demonstrations in this final section. The first teaches the students how to estimate the R-value of a wall and the second is a computer-aided "energy audit" for a house.

4.0 DEVELOPMENT AND USE OF THE MATERIALS

The development process took from August 1981 until December, 1982. In all there were nineteen meetings held, involving the consultant's project team meeting by itself or with the advisory committee. This process ended when the materials were printed ready for purchase by the schools. The following people took part:

TABLE 1

PARTICIPANTS

Role	Name	Employer
PROJECT TEAM		
Project Co-ordinator	S. Washburn, P.Eng	Washburn & Gillis
Education Advisors (all teachers)	D. Coughey	Retired Principal
	R. Wilton	Washburn & Gillis
	P. Fournier	Washburn & Gillis
Technical Writers	L. Patenaude	Washburn & Gillis
	D. Folster	Washburn & Gillis
ADVISORY COMMITTEE		
Advisor	M. Robichaud	N.B. Energy Secretariat
Science Consultants	C. Landry	N.B. Dept. of Eduction
	G. Léveille	N.B. Dept. of Eduction
	L-P. Charest	N.B. Dept. of Eduction
	A. Hammond, PhD	N.B. Dept. of Eduction
Teacher	C. Ripley	District 25

Only two science consultants served on the advisory committee at any given time. Messrs. Landry, Léveille and Charest succeeded each other

on the committee. Dr. Hammond was a member of the committee from start to finish. He was the Project Manager.

The process of developing the materials was divided into four stages each of which took about four months. At the end of the planning stage the form and content of the materials were determined. This took from August until early December, 1981.

The rough draft was produced in December and January. It was revised and rewritten and related materials, including the demonstration materials, were assembled. This development stage took place from December, 1981 until April, 1982.

The teachers were introduced to the materials during a professional development day on the 23 April, 1982. The trial runs took place that spring and the evaluations were incorporated into the materials during the summer. This was the third stage.

The fourth and final stage was the production of the materials. In the fall of 1982 the first edition of the student text was printed, ready for use early in 1983. The accompanying teacher manual was photocopied by staff of the Department of Education. The only other material sent out at that time was a smoke pencil kit. This device has not been included with subsequent mailings.

At this point the involvement of the consulting firm, Washburn & Gillis officially ended. Unfortunately, personnel of the Department of Education also changed at Christmas, 1982. Dr. Hammond had been the motivating force behind this project and it was then that he accepted a job in another province. His position in New Brunswick was not filled until the summer of 1983. There was no continuity of personnel in the position of Science Consultant of the Department of Education. Even if there had been, it would be rare to find the same commitment to the subject of energy conservation or to the process of developing educational materials with a regional flavour.

A second contract with the New Brunswick Energy Secretariat provided for further course evaluation and paid for this final report. However, the province-wide teacher training and the course evaluation and up-dating that was mentioned in the original proposal has not been carried out by the Department of Education.

5.0 COST ANALYSIS

The original budget for this project differs from the final costs. The true cost is the useful figure if further work of this kind is to be undertaken. Printing costs for the trial run and translation costs exceeded the budget because both of the texts were longer than expected. Supervisory time had been underestimated as well (see Table 2). Although the client extended the total budget by about $4800, the consultant absorbed a larger share (almost $5500) of the over-run. This is a good investment in developing the skills in the firm and in the region. In fact, the consultant has continued to be involved since December 1982 in order to ensure the quality and the continuing availability of the materials in the schools.

The costs are broken down two ways. In Table 2 the overall budget is given for three categories: original cost, cost paid and actual cost. Table 3 shows the actual costs of the four development stages.

A great deal of time was spent at the beginning selecting the topic for this first project. One topic was pursued to some lengths only to be rejected completely. Further units developed for General Science 10.3 would not have required more than a month for the planning stage.

The probable topic for the second project would have been the conservation of fuels in engines, since this group of students also would be involved with cars and trucks either in use or maintenance. They would relate to this topic as well or better than they relate to houses and housing.

TABLE 2
OVERALL BUDGETS

Items	Budget	Paid	Actual
FEES			
Project Co-ordinator	7200.	8818.43	14280.
Education Advisor (Anglophone)	1935.	1935.	1935.
Education Advisor (Francophone)	2365.	2365.	2365.
Technical Writer (Anglophone)	1075.	1290.	1290.
Technical Writer (Francophone)	2150.	4300.	4300.
Sub Total	14725.	18708.43	24170.
DISBURSEMENTS			
Secretarial	1500.	1363.25	1363.25
Materials	1750.	824.64	824.64
Photocopy/Printing	300.	3128.61	3128.61
Meeting/Travel	1000.	191.75	191.75
Supplies	200.	32.70	32.70
Subtotal	4750.	5540.95	5540.95
Total	19475.	24249.38	29710.95

TABLE 3
COST PER PHASE

Phase	Duration in months	Cost $
1. Planning	Four	7818.22
2. Development	Four	5457.35
3. Trial Run and Revisions	Four	8650.23
4. Editing and Printing	Four	7785.15
TOTALS	Sixteen	29710.95

Subsequent units would take less time in every phase because chapter one would not need to be duplicated since it contains general information on energy use. Later course inclusions would need only two chapters to cover the topic, a theoretical chapter and a practical hands-on chapter.

6.0 EVALUATION

6.1 Trial Run

The project was evaluated during the trial run and the comments from the teachers and students from the six classes resulted in the texts being much improved. Some illustrations came under criticism and were redrawn. The introduction for chapter two was rewritten. There were positive comments as well. The pictures, diagrams, tables, etc., were all desirable. All of the demonstration experiments were well received. A copy of the evaluation is shown in Appendix B.

One of the criticisms was that the class time allotted to each chapter wasn't long enough. The trial runs took place in May and June of 1982. None of the teachers had left enough time so none of them finished the project. None of them used the computer program or evaluated chapter three fully.

6.2 Final Report

A second evaluation was undertaken in 1984 under a second contract to the N.B. Energy Secretariat. In May a letter was sent to the principals or the science department heads of forty-nine senior high schools in New Brunswick. Attached was a questionnaire. A copy of the letter and the questionnaire can be seen in Appendix C. A summary of the statistics on the schools is seen in Table 4 below.

TABLE 4

1984 SCHOOL SURVEY

Involvement of the Schools	Number
Sent questionnaire	49
Responding	30
Not teaching Physical Science 10.3	14
Not teaching Physical Science 10.3 but wanting materials for other courses	2/14
Teaching Physical Science 10.3 (including one teaching it alternate years)	16
Teaching course but not "Energy Conservation and Space Heating" Unit	4/16
Obtained part of the materials but didn't use	1/4/16
Obtained materials and will use next year	2/16
Wants to use next year but hasn't got materials	2/16
Has obtained and used materials	8/16

It is interesting to note that the eight classes reporting on the use of the materials represent the use of about 280 student manuals (8*35). Yet there have been three printings of these texts. In the first two, 1500 and 275 were printed (1983, L. Bartlett, Department of Education, personal communication). The third time 547 were printed (1985, D. Toole, Department of Education, personal communication). Of these 2322 texts only 99 remain to be distributed by the School Book Branch.

The eight senior high schools who responded to the questionnaire and who use the "Energy Conservation and Space Heating" unit are listed in Table 5 below. Table 6A shows the evaluation of each of the chapters and

Table 6B describes the materials received. The bottom lines in Table 6B evaluate the student's understanding of various topics as a result of this course inclusion.

TABLE 5

SCHOOLS EVALUATING UNIT

School District	Name of Senior High School	Name of Principal	Name of Teacher
08	Miramichi Valley High	C.I. Hubbard	E. Pinder
09	Upper Miramichi Regional	D. O'Donnell	D. O'Donnell
19/20	Kennebecasis Valley S.H.	W.J. Bishop	D. Storey
20	Saint John Vocational	R. Taylor	R. Gray
26	Fredericton High School	R. Woodward	T. Rulier R. Duplisea
28	Nackawic High School	K. Scott	R. Squires
33	Cité des Jeunes A.M. Sormany	J. Levesque	R. Berubé
38	Sugarloaf Senior High	D. Henderson	P. Duncan W. Smith

TABLE 6A

SUMMARY OF EVALUATION OF "ENERGY CONSERVATION AND SPACE HEATING" UNIT

	School District							
	08	09	19/20	20	26	28	33	38
Chapter 1								
Student Manual								
Text	2	1	1	2	1	1	1	2
Illustrations	2	1	1	1	2	1	1	1
Questions	2	1	1	3	1	1	1	3
Teacher Manual								
Text	2		1		1	1	1	1
Quest & Answers	1		1		1	1	1	1
Chapter 2								
Student Manual								
Text	2	1	1		1	1	1	3
Illustrations	2	1	1		2	1	1	2
Questions	2	1	1		1	1	1	2
Demonstrations	2	1	1		3	1	1	2
Teacher Manual								
Text	1		1		1	1	1	1
Quest & Answers	1		1		1	1	1	1
Chapter 3								
Student Manual								
Text	3	2	1		1	1		
Illustrations	1	2	1		2	1		
Computer Program	1		1		3	1		
Teacher Manual								
Text	1		2		1	1		
Computer Information	2		2		3	1		
Comments		Would like to receive other material.		Redundant and trivial	Useful. Accomplished goals. Some redundancy. Parts too technical. Need more multiple choice. Need more time.			Need 6 weeks. Tape incompatible. Some level 4 students.

Evaluation Code: 1 = Valuable, 2 = Useful, 3 = could be improved.

TABLE 68

SUMMARY OF EVALUATION OF "ENERGY CONSERVATION AND SPACE HEATING" UNIT

	School District 08		09		19/20		20		26		28		33		38	
MATERIALS	REC'D	NEED	RED'D	NEED	REC'D	NEED	REC'D	NEED	REC'D	NEED	REC'D	NEED	REC'D	NEED	RED'D	NEED
Student Manual	Y		Y		Y		Y		Y		Y		Y		Y	Y
Teacher Manual	Y		N		Y				Y		Y		Y		Y	Y
Smoke Pencil	Y		Y		Y				Y		N	Y	Y		N	Y
Multiple Choice Items	N	N	N		N				N		N	Y	Y		N	N
Computer Disk or Tape	N	Y	N		Y				Y	N	N	Y	Y		Y	Y
NRC B.P. Notes 20 & 26			N						N	N	N	Y		N	Y	Y
Blank Forms B1, B2, B3	N	Y	N						N	N	N	N		N	N	N
B1, B2, B3 Completed	N	Y	N						N	N	N	N	Y		N	Y
CLASS PERIODS																
Chapter 1		6		5		5		5		8		8		10		8
Chapter 2		4		5		5				4		10		8		4
Chapter 3		8		2		4				3		4		0		
Total Class Periods		18		12		14		5		15		22		18		12
STUDENT UNDERSTANDING																
Energy for N.B.	Improved		Improved		Improved		Improved		Improved		Improved		Improved		Improved	
Energy transfer/convers.	Improved		Improved		Improved		Not Improved		Improved		Improved		Improved		Improved	
Need for Energy conservation.	Improved		Improved		Improved		Improved		Improved		Improved		Improved		Improved	
Conservation through house construction, operation.	Improved		Improved		Improved				Improved		Improved		Improved		Not Improved	

7.0 CONCLUSIONS

The aims of the project have been met. Students in the general and occupational program have been provided with instructional materials that have stimulated their interest in energy supply and demand for the province, the region and the country. It teaches them to differentiate between renewable and non-renewable energy and gives them a better understanding of the need for conserving the latter. Using the concepts of energy balance and heat transfer, they have developed an understanding about the ways to conserve energy in buildings.

The texts for "Energy Conservation and Space Heating" complement the other material given to the General Science 10.3 students. The demonstration experiments on energy are needed and have proved valuable. The students can understand the information. The teachers want to use the texts.

8.0 RECOMMENDATIONS

The province-wide teacher training, regular evaluation and updating which were part of the overall plan, but not part of this project, suffered a blow when Dr. Hammond, a Science Consultant with the Department of Education left the Department. For six months there was no one in this position. It is unreasonable to expect the new appointee, who has a whole range of new situations and problems to cope with to put the same emphasis on this topic. This unit is only a small segment of one of the many courses under his jurisdiction. However, there are some things that could be done from within the department to make the best use of these materials.

Not all of the teachers who have ordered these texts have received the teacher manuals to go with the student manuals. The most negative comments (see Table 6A and B) were from a teacher who never received the teacher's manual. The teacher manual was, with few exceptions, ranked "valuable". It should be ensured that one copy goes with each new order of student texts and to those who did not get them previously.

Some of the partially-completed and fully-completed forms for use with the computer were left out of the teacher manual. These should be sent out to the teachers and incorporated in later versions of this text. It would make the computer program easier to use.

At least one version of the computer program has been reported to be defective (1984, L-P. Charest, Department of Education, personal communication). Since 1981, computer programs have become much more sophisticated. This program would be improved by being made more "user friendly".

The recommendations to the Department of Education are that some fine tuning of the materials be carried out, that the teacher manual be sent with the student texts and that the course be more widely promoted. A number of requests for information were received with the questionnaires.

The recommendation to the client is that programs to educate the public about energy conservation be continued, both in the schools and to homeowners. This will result in energy-conscious changes to the building stock and to lifestyle, both of which will conserve non-renewable energy.

APPENDIX A

MATERIALS DEVELOPED

APPENDIX A-1

TABLE OF CONTENTS OF STUDENT MANUAL

Page

STUDENT MANUAL

CHAPTER 1 ENERGY

1.0 What is energy 1

1.1 The earth's energy supply 3

1.2 The earth's energy needs 4

1.3 The economics of oil 6

1.4 Canadian energy situation 7

1.5 The New Brunswick energy situation ... 13

1.6 Energy choices for New Brunswick 15

Questions for directed reading 21

CHAPTER 2 SPACE HEATING IN HOMES

2.0 Evolution of housing 27

2.1 Basic shelter 27

2.2 Housing and heating options 28

2.3 Heat transfer methods 28

2.3.1 Radiant heat transfer 29

2.3.2 Heat transfer by convection 31

2.3.3 Heat transfer through conduction 36

2.4 Construction and operation of a house 43

2.4.1 Use of a vapour barrier 43

2.4.2 Sources of infiltration 46

2.4.3 Lifestyle 47

2.4.4 Shaping the house to the elements 49

Questions for directed reading, ... 51

Page

CHAPTER 3 ESTIMATING ENERGY SAVINGS

3.0 Preliminary information 53

3.1 Fuel costs 54

3.2 Component sizes and construction 54

3.3 Infiltration rate 55

3.4 Costs 57

3.5 Degree days 57

3.6 Payback times 58

APPENDICES

APPENDIX A Average Thermal Resistance of Housing Components A1

APPENDIX B Micro Computer Analysis of the Energy Used in a House B1

APPENDIX C Glossary of Terms C1

EXPERIMENTS

2.3.1 1 Radiant heat transfer 29

2.3.2 2 Convection of heat energy 32

2.3.3 3 Conduction of heat energy 38

2.3.3 4 Insulating value of materials ... 39

2.4.1 5 Best location for vapour barrier. 44

APPENDIX A-2

TABLE OF CONTENTS OF TEACHER MANUAL

UNIT 1

TABLE OF CONTENTS

	Page
TEACHER'S MANUAL	
Introduction	ii
Contents	iii
CHAPTER 1 ENERGY	
Overview	1
Objectives	1
Outline	1
Time allotment	3
Motivation	3
Developing the lesson	3
Questions for directed reading	6
Terms	30
CHAPTER 2 SPACE HEATING IN HOMES	
Overview	31
Objectives	31
Outline	31
Time allotment	33
Motivation	33
Developing the lesson	33
Questions for directed reading	39
Terms	48

Page

CHAPTER 3 ESTIMATING ENERGY SAVINGS

Overview 49

Objectives 49

Outline 50

Time allotment 50

Motivation 50

Developing the lesson 50

Terms 51

EVALUATION 52

MULTIPLE CHOICE ITEMS 53

SAMPLE HOUSE INFORMATION 61

SAMPLE HOUSE PROBLEM 62

BIBLIOGRAPHY 69

FIGURES

1. Price for regular gasoline and fuel oil, 1973-82 24

2. Typical curves for Exp. IV 36

APPENDIX A-3

KIT LIST FOR TRIAL RUN

KIT NUMBER:

EXPERIMENT NUMBER	MATERIAL	NO. IN KIT
1	Candles	6
1, 2	Matches	1 pk.
1, 2	Cardboard	1
1	Tinfoil tart plates	10
2	Cardboard box	1
2	Acrylic sheet	1
2	String	.5 m
2, 5	Masking tape	1
2	Smoke pencil kit	1
2	Instructions	1
2	2 drager tubes	2
2	2 bulbs	2
2	1 box	1
3	rods aluminum	1
3	brass	1
3	steel	1
3	wood	1
4	thermometers (long)	8
4	large test tubes	16
4	graph paper	1 pk.
4	polystyrene blocks	4
4	plastic bags	4
4	fibre glass	8 L
4, 5	cellulose	> 8 L
4	sawdust	8 L
4	icecream containers	12
5	Cardboard tubes	1
5	Plastic cups	8
	Thermometers (plastic backed)	3
	- Tape measures	4
	Casette tapes	1
Computer Program	Pads of B1 B2 B3	
	- Building Practice Note 20	1
	- Conserver House	3
	- Home Energy Fact Sheet	32
	- First Seal Your House	32
	Commencez ... maison	-

APPENDIX A-4

INTRODUCTORY LETTER FOR TRIAL RUN

Dear Teacher:

Thank you for agreeing to help us evaluate material on "Energy Conservation and Space Heating" that will be included as part of the 10.3 Physical Science Course in New Brunswick Schools next fall. The Trial Run that you are going to conduct with your students is a very important part of the development of these materials. Based on your experience, the course inclusion on Energy can be adapted to best suit the needs of New Brunswick teachers and students.

The very first step in the Trial Run is to give the students the enclosed pre-test. The results of this pre-test will gauge the level of awareness that the students have about energy and energy related topics and their attitude toward these subjects before they are exposed to the unit. The pre-test is far more general than the questions asked in the manual for the students, or in the test items given in the manual for the teachers. It is just one of the tools for evaluating these materials.

The course material on "Energy Conservation and Space Heating" is one of the Small Scale Conservation and Renewable Energy Demonstration Programs funded jointly by the Government of Canada and the Province of New Brunswick.

In the kit, with which you are provided, are materials for a number of small experiments to demonstrate the various aspects of heat transfer, especially as it applies to heat loss from houses. There is also a micro-computer program that the students will use to analyse energy use in buildings.

Introducing and supporting these materials is a 120 page student manual. To assist the teacher, there is a teacher manual which gives (for each of the three chapters) an overview, the objectives, an outline, the time allotment, how to motivate the students and develop the lesson, and questions for directed reading. Also included are objective test items at the end of the teacher manual.

This material has been developed in the province by New Brunswickers. Now we are asking New Brunswick teachers and students to help us evaluate it to make it better.

Please either send us the pre-test or keep it to send with a post test that we will be supplying to you. Would you also please make us a copy of your own evaluation procedures and the tests that you have used for this trial run.

Thank you.

Yours truly,

Science Advisor
Department of Education
P.O. Box 6000
Fredericton, New Brunswick

APPENDIX A-5

PRE-TEST FOR TRIAL RUN

PRE-TEST FOR STUDENTS UNDERTAKING

TRIAL RUN OF ENERGY DEMONSTRATION PROJECTS

1. Would you say that the house/apartment/mobile home in which you live is:

   A not insulated
   B poorly insulated
   C well insulated
   D don't know

2. In New Brunswick the energy to run the industries, power plants, cars and trucks and to heat the houses comes mostly from

   A coal
   B oil
   C wood
   D other sources

3. Four of New Brunswick's energy resources are listed. Which one is most plentiful?

   A coal
   B peat
   C oil shale
   D uranium

4. Gasoline now costs about 43 cents per litre. Ten years ago the cost was approximately

   A 43 cents per litre
   B 20 cents per litre
   C 10 cents per litre
   D 1 cent per litre

5. Which one of the following R-values (or RSI values) is reasonable for the attic of a N.B. house with good insulation?

   A R = 5 (RSI = 0.9)
   B R = 10 (RSI = 1.8)
   C R = 40 (RSI = 7.0)
   D R = 100 (RSI = 17.5)

6. The most widely-used source of heat for New Brunswick homes is:

   A electric heat
   B wood stove or furnace
   C coal stove or furnace
   D oil stove or furnace

7. The Sun's energy is transported to the Earth by

   A radiation
   B convection
   C conduction
   D infiltration

8. Select the one true statement.

   A Only hot objects radiate energy.
   B Radiation and conduction are basically the same.
   C A house does not radiate heat to the surroundings.
   D All objects radiate energy, hottest ones the most.

9. At present, Canada has enough available oil reserves to supply all Canada's oil needs for approximately

   A 10 years
   B 80 years
   C 200 years
   D 1000 years

10. Most improvements to save energy in houses cost money. The payback period for an improvement is

   A The time it takes to pay off the loans or installments for the work and materials.
   B The six or eight months of winter in each year.
   C The time it takes for energy cost savings to equal the cost of improvements.
   D The time it takes to complete the improvements.

11. The purpose of a vapour barrier is

A to reduce air leakage
B to improve the insulation level
C to keep moisture from getting into the house
D to prevent moisture from getting into the walls

12. In a warm house on a winter's day the temperature of a window is usually lower than the wall beside it. The reason is that

A smooth materials are colder than rougher materials
B glass cools off quicker than wood or plaster
C windows usually conduct heat away better than walls
D windows have a less area than walls

13. A high R-value (or RSI value) for an insulating material means

A it is very hard and rigid
B it resists moisture very well
C It is a poor conductor of heat
D it is a good conductor of heat

14. Older houses didn't need vapour barriers because

A water vapour was carried away through air leakage
B very little water vapour was produced in the houses
C plastic (polyethylene) was not invented
D thick walls were not damaged by water vapour

15. Beside each of the following put the letter R if it is a renewable form of energy or the letters NR if it is non-renewable.

i) _____ coal
ii) _____ uranium
iii) _____ wood
iv) _____ energy from tides
v) _____ wind energy
vi) _____ oil
vii) _____ energy from a hydro dam
viii) _____ peat

16. In the last few years many people have been talking about energy conservation. You may have read about it in the papers, heard about it on radio or TV, or studied it in school. List the things you have learned about how to <u>save energy in the home</u>.

17. Do you enjoy learning about energy conservation? If you do explain why.

18. If you do not explain why.

19. I think it is important to learn about energy conservation because:
(list reasons)

20. I think it is not important to learn about energy conservation because:
(list reasons)

APPENDIX B

EVALUATION OF TRIAL RUN (1982)

Notes on Energy Education Unit

from Pilot Teachers

CHAPTER 1

1. Many students still not clear about difference between 'joule' and 'watt'. They could follow the snow shovelling example okay but couldn't remember the distinction from that example alone.

2. Students had trouble relating to the global scale of Sec. 1.1. Sections 1.0 and 1.3 and 1.5 received the best response. One teacher suggested that working from the local to the global, Sections 1.0, 1.5, 1.3, 1.4. 1.2 and then 1.1, might be an improved instructional sequence for the chapter.

3. Fig. 1.1 is not as successful as it could be. For example:

   (a) Title says energy, but amounts are stated in power units.

   (b) Some quantities have percentages by them, others do not.

   (c) Many students couldn't see why the arrows for winds/waves/currents, for evaporation/precipitation and for direct conversion to heat pointed back out into space.

   (d) Some couldn't see why an arrow should point from 'animals' to 'fossil fuels'.

4. The units 'petajoules' and 'terajoules' leave students cold. Could these units be explained in terms of tank cars of oil, or annual output of Mactaquac, or some other more meaningful comparison?

5. The flow diagram of Fig. 1.2 worked well. Students were stimulated by the related questions. Perhaps more could be said in defining 'resource' and 'reserve'.

6. Fig. 1.3 and 1.4A are both rather cluttered. Could teachers be provided with transparencies of these graphs with separate overlays to examine each line at a time?

7. Fig. 1.5 made its point very well, as did Fig. 1.6.

8. Fig. 1.7 could be improved if lines were drawn connecting labels to corresponding sectors of pie graphs.

9. Students were very interested in the figure showing location, size and type of generating stations in N.B.

10. Could the questions for Sec. 1.0 be placed immediately after Sec. 1.0, those for Sec. 1.1 immediately after 1.1, etc.

11. Pictures, diagrams, tables, etc. are all desirable. Students learn from them more easily than from printed word.

CHAPTER 2

1. Sec. 2.0. Some students said: "If you wanted to heat the outdoors, why would you bother to build walls and roof? You would simply build the fire outside in the first place."

2. Sec. 2.1 seems to presuppose students know about radiation.

3. Sec. 2.0 also presupposed students have done convection.

4. Sec. 2.3.1 2.1. Experiment went well. However, students were not able to separate conceptually radiation from conduction and convection. Would it be better to do conduction and convection experiments first (these experiments seem to rely more closely on direct evidence and less upon inference), then the radiation

experiment? Questions would then have to be added to Exp. 1 asking students why the heat, or coolness, they felt was not due to convection or conduction rather than radiation.

5. Someone wanted to know: how does the amount of heat radiated from the outside of a house in January compare with the amount carried away by conduction to the outside air? How does the comparison vary for well- and poorly-insulated houses?

6. Exp. 2 worked very well. Students were fascinated by smoke pencils and wanted to know how they worked. Could details be added in the teachers guide?

7. Exp. 3 worked well. (Why not use arabic rather than Roman numerals for experiment numbers?)

8. Exp. 4 worked well. By the time all students got pre-boiled water from kettle, temperature had dropped considerably. However, the decreases in temp. over 10 min. showed effects clearly even if the final temperature readings were not so convincing of the effects.

9. Suggest modification of data table for Exp. 4 so that head for Column 1 becomes Time of Reading, then columns 2, 4, 6 can be deleted.

10. Could sections 2.0 to 2.3 be edited so that Sec. 2.0 lays groundwork of need for heat conservation in houses, perhaps with a sketch diagram of a house labelled to show various main ways heat escapes, to be followed in order by sections on convection, conduction and radiation.

11. Questions at end of chapter could be distributed throughout chapter at end of each section.

CHAPTER 3

None of the pilot teachers had yet completed this chapter.

ADDITIONAL COMMENTS:

1. One teacher discovered that quite a few students think potash is a fuel.

2. Another teacher noted that many students have negative attitudes on some energy issues e.g., (a) Why shouldn't Canadians use more fuel than most people?; It is a wide, cold country. (b) Why should we conserve energy? Someone else will use it if we don't. (c) The oil companies are out to "get" us by pretending supplies are short and then charging exorbitant rates.

APPENDIX C

1984 EVALUATION

APPENDIX C-1

1984 LETTER TO PRINCIPALS

MEMORANDUM

TO: Principals of Senior High Schools, or Science Department Heads.

FROM: Sheila Washburn

DATE: May 16, 1984

SUBJECT: Evaluation of Energy Conservation and Space Heating Unit for Physical Science

---

In 1983 new supplementary student and teacher manuals were listed in the Curriculum for Physical Science. They were for a 3 to 4 week Unit for 10.3 Physical Science called Energy Conservation and Space Heating.

These student and teacher manuals were developed in New Brunswick by a team that was composed of teachers, a professional writer, technical people, and Science Consultants of the Department of Education. The development process included a trial run as well as an evaluation of the materials after they had been in use for a year. We need your cooperation to finish this final phase.

A questionnaire is attached. If these materials have not been received or used by your school would you please indicate that that is so and return the form in the stamped addressed envelope enclosed.

If your school has used the materials we would appreciate it if you would give the questionnaire to the teacher who used them so that he or she can fill it in and return it to us. Thank you.

S E Washburn

Sheila Washburn
Project Coordinator

SW/ll
Enclosure

APPENDIX C-2

1984 QUESTIONNAIRE

QUESTIONNAIRE

10.3 Physical Science Unit on
Energy Conservation and Space Heating

1. Name of School: _____

2. Name of Principal: _____

3. Does your school offer Physical Science 10.3: Yes ____ No ____

4. Name of Physical Science teacher: _____

5. Did your school use the Unit on Energy Conservation and Space Heating that is listed in the Curriculum for physical science? Yes___ No___

6. Were these materials used by students other than for the Physical Science Teacher? Yes ____ No ____

7. Name of teacher who used these materials, if not Physical Science Teacher: _____

   Course: _____

8. a. Which of the following materials did you receive for teaching this Unit?

   b. If not received, which of these materials would have improved the Unit?

	Received		Needed	
	Yes	No	Yes	No
Student Manuals	___	___	___	___
Teacher Manuals	___	___	___	___
Smoke Pencil	___	___	___	___
Multiple Choice Items (without answers marked)	___	___	___	___
Computer Diskette	___	___	___	___
NRC Building Practice (Notes 20 and 36)	___	___	___	___
Blank forms (B1, B2, B3)	___	___	___	___
Forms fully & partially completed for Appendix B	___	___	___	___

Other: _____

_____

_____

9. How many class periods did you spend on this Unit for:

Chapter	No. of Class Periods
1	_____
2	_____
3	_____

10. Please rank the various components of this Unit:

	Valuable	Useful	Could be Improved
Chapter 1			
Student Manual			
Text	____	____	____
Illustrations	____	____	____
Questions	____	____	____
Teacher Manual			
Text	____	____	____
Questions(answers)	____	____	____
Chapter 2			
Student Manual			
Text	____	____	____
Illustrations	____	____	____
Questions	____	____	____
Experiments	____	____	____
Teacher Manual			
Text	____	____	____
Question(answers)	____	____	____
Chapter 3			
Student Manual			
Text	____	____	____
Illustrations	____	____	____
Computer Program	____	____	____
Teacher Manual			
Text	____	____	____
Computer Program information	____	____	____

11. Through the use of these materials did the students improve their understanding of:

	Yes	No
1. Energy supply and demand for New Brunswick?	___	___
2. Energy conversion and transfer?	___	___
3. The need to conserve energy?	___	___
4. The ways of conserving energy in the construction and operation of a house?	___	___

We would appreciate receiving any further comments.

Thank you for your help in evaluating this Unit.

Sheila Washburn
Washburn & Gillis Assoc. Ltd.
70 York Street
Fredericton, N.B., E3B 3N5